Challenges of Using the TTWCS and TC2S to Enable Retargeting of TACTOM Missiles Against a Moving Target

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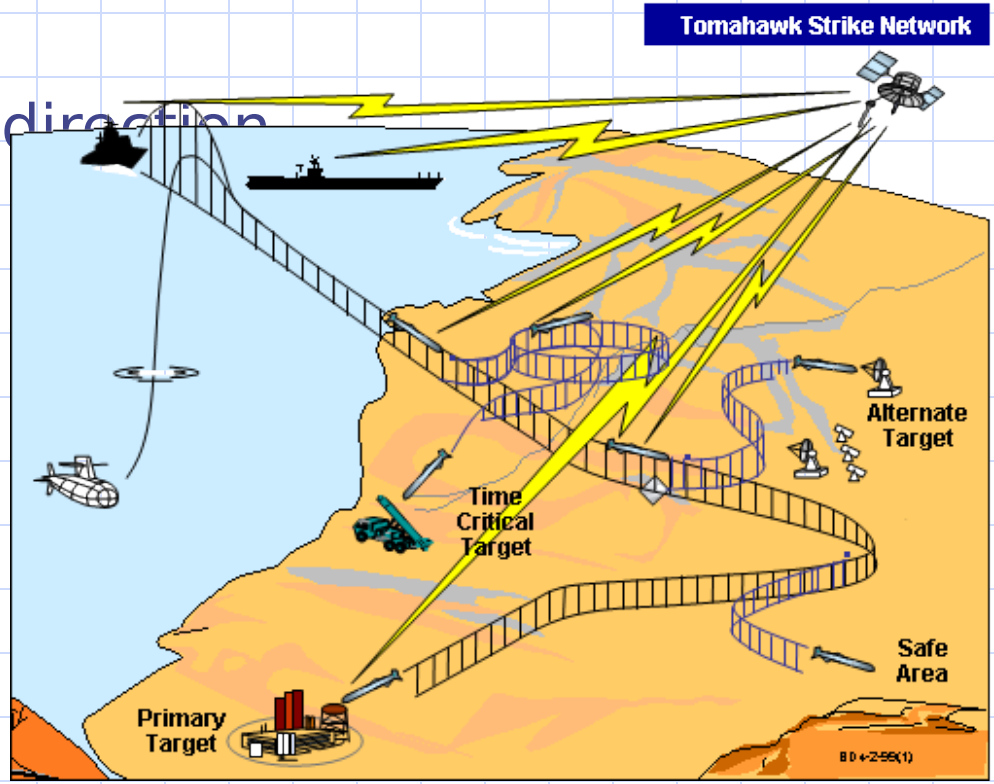
13 October 2004

Outline

- Tomahawk Weapon System, Baseline IV
- Tomahawk Strike Network (TSN)
- Problem of Applying to Large Moving Targets
- Theoretical Implementation
- Assumptions Used for Study
- Simulation Program
- Study Results
- Further Recommendations
- Conclusions

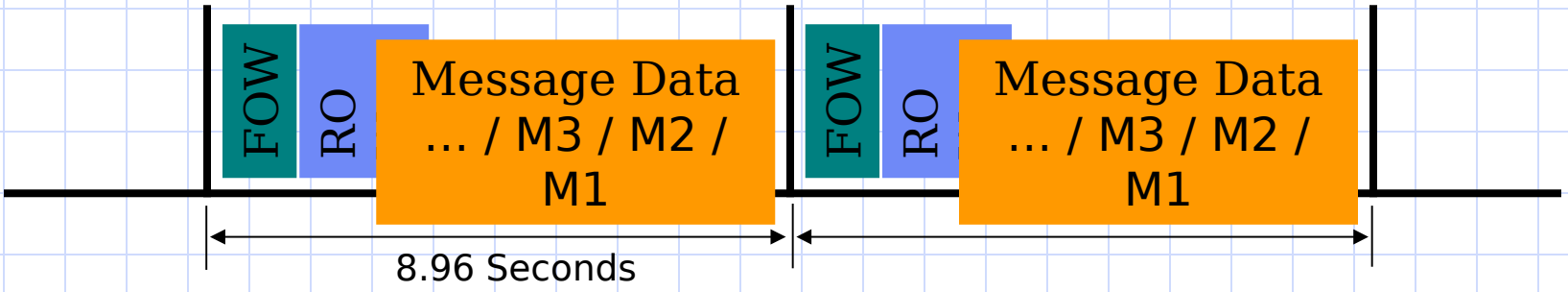
Tomahawk Weapon System, Baseline IV

- Tomahawk employs GPS as main flight guidance system
- The Block IV All Up Round can be redirected after launch
- Three methods of redirection are possible
  - Flex
  - Retarget
  - Aimpoint Update
- Communications possible throughout 900 NM flight range



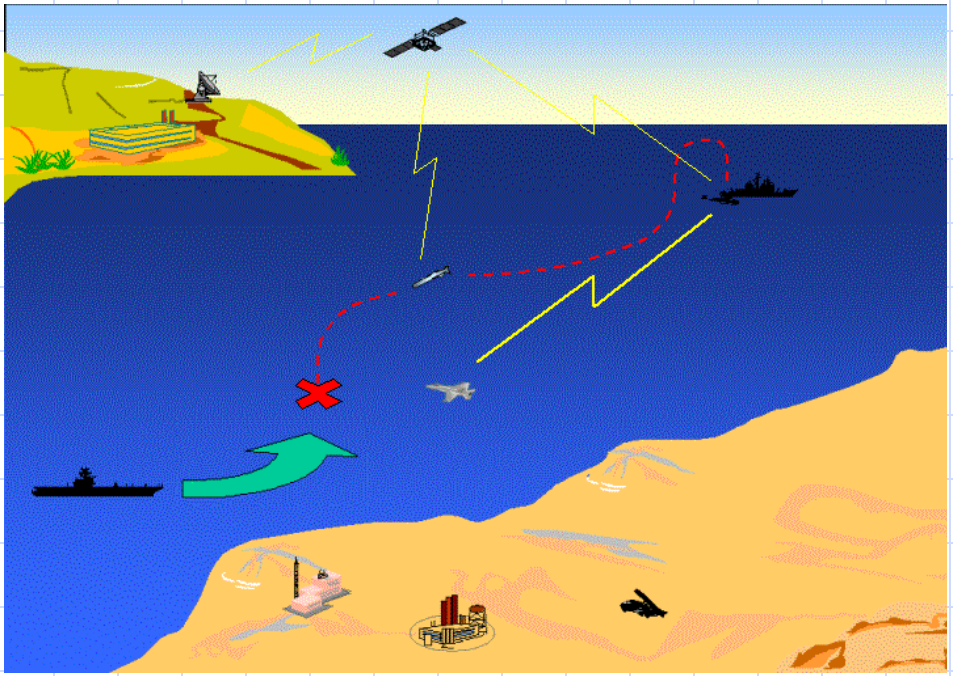
Tomahawk Strike Network (TSN)

- Uses standard 5 kHz UHF DAMA circuits
- Messages are divided up into packets that can be sent at approximately 9 second intervals
- A complete Aimpoint Update message can fit into a single packet



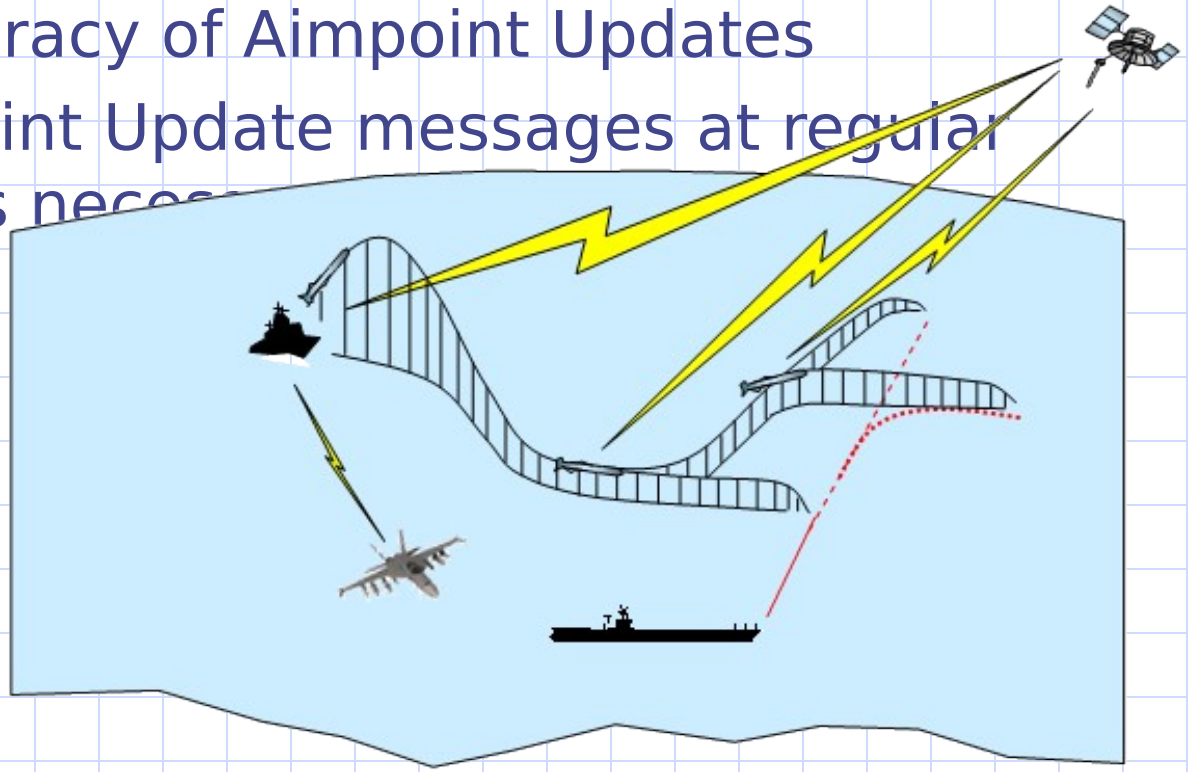
Problem of Applying Tomahawk Missiles to Large Moving Targets

- How far can a target depart from its original track in a given amount of time?
- What are the critical issues?
  - Target Maneuverability
  - Target Size
  - GPS/Targeting Errors



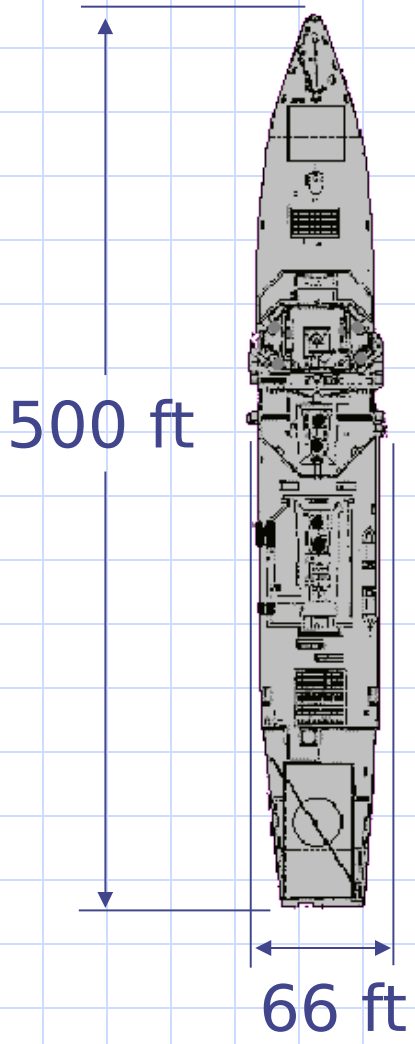
Theoretical Implementation

- Mission created to target expected final position
- Have observer(s) report position of target to ensure accuracy of Aimpoint Updates
- Send Aimpoint Update messages at regular intervals (as neces

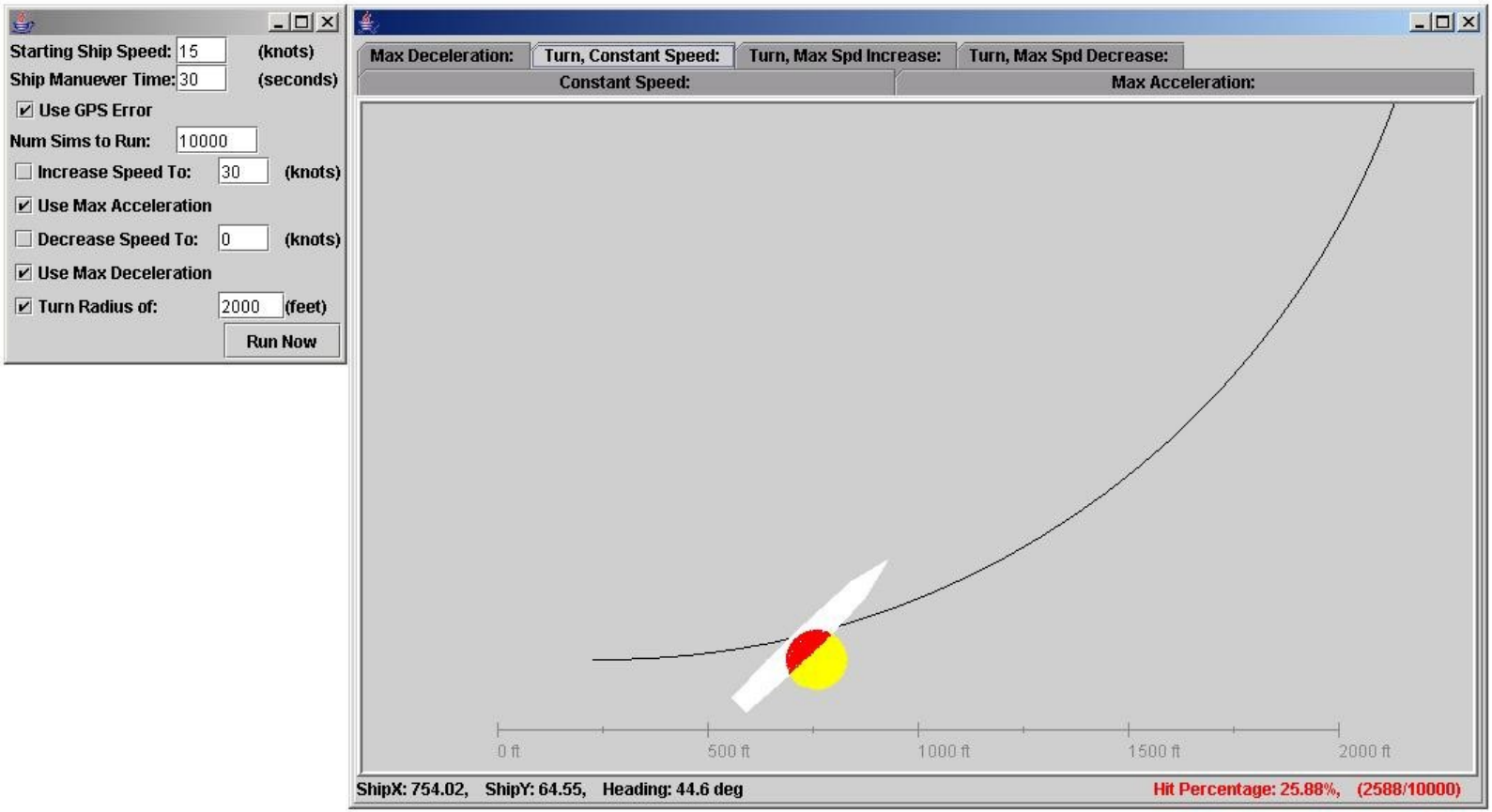


Assumptions Used For Study

- Modern destroyer sized vessel about 8,000 tons; Same size as a cruiser in Crenshaw's *Naval Shiphandling*
- Maneuvering capabilities
  - Acceleration
  - Turning radius
- GPS/Targeting accuracy
- Simplified physics model for ship motion

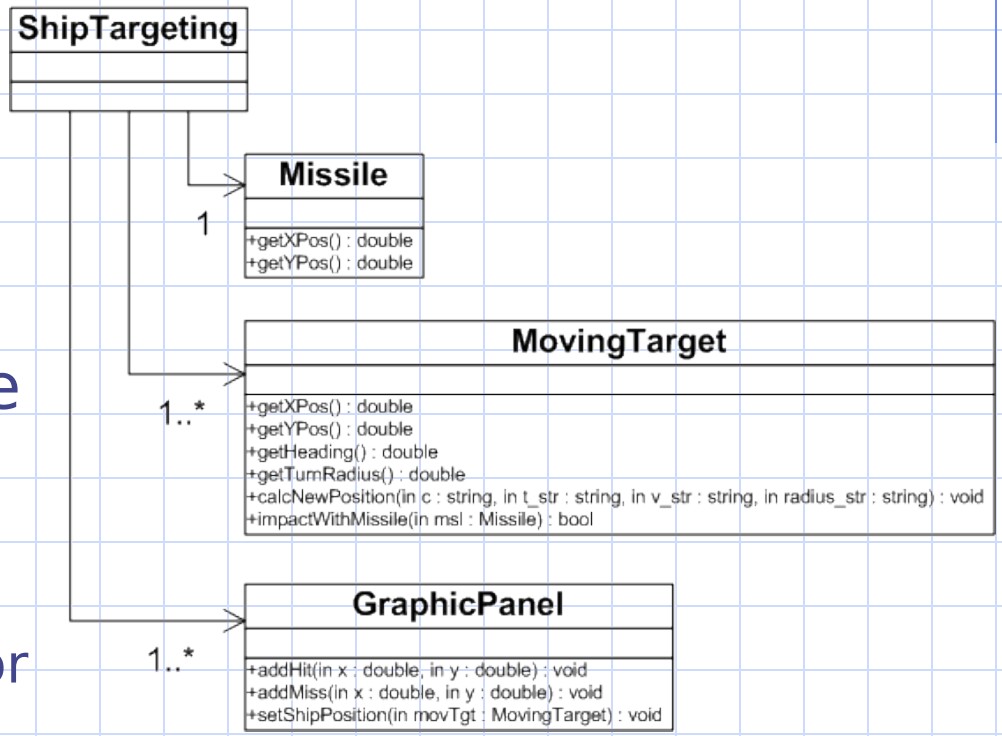


Simulation Program

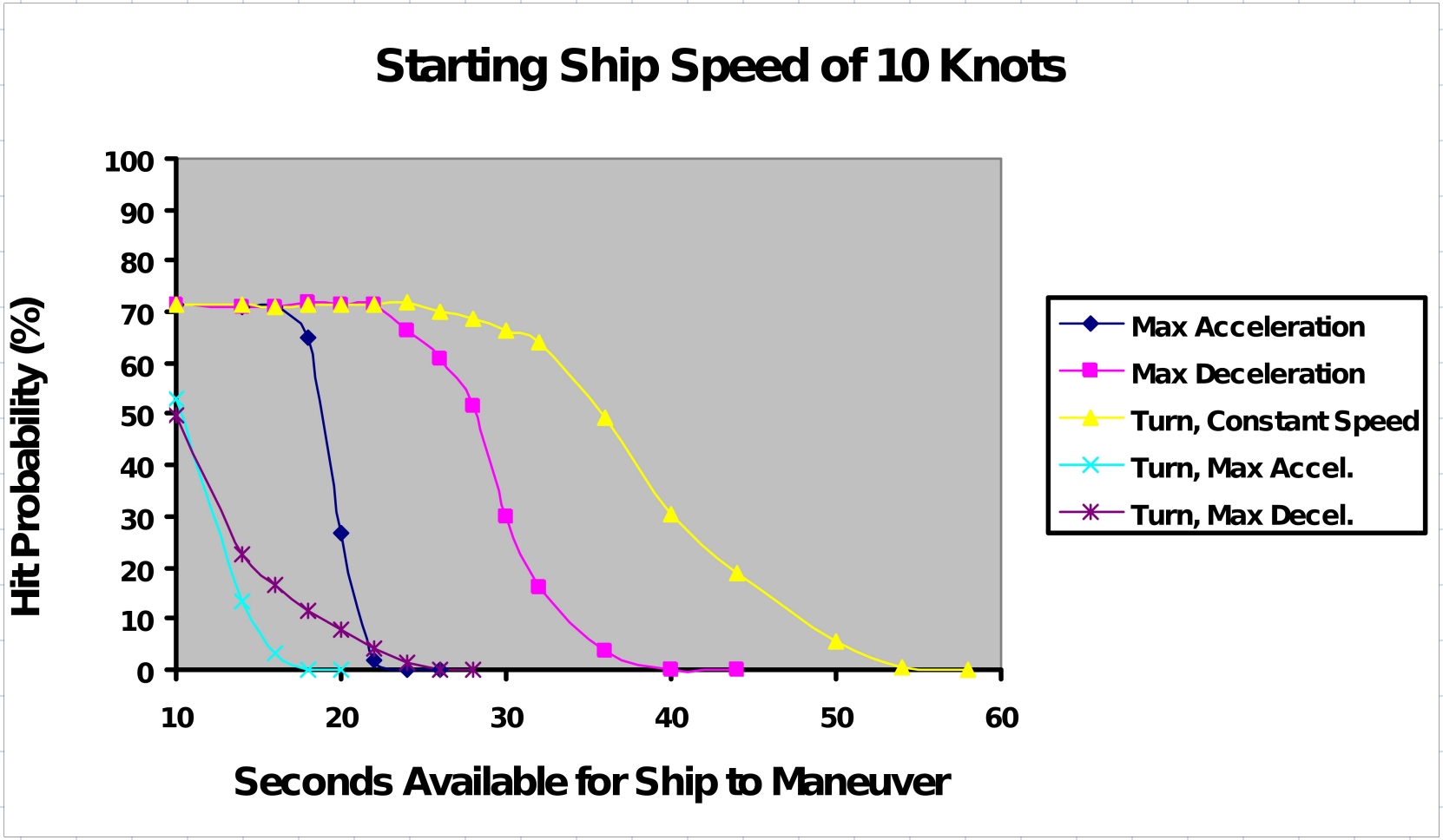


Simulation Program Architecture

- Java classes
  - ShipTargeting
  - Missile
  - MovingTarget
  - GraphicPanel
- Program sequence
  - Moving targets created
  - Missile created
  - Targets checked for impact by missile
  - Hit/Miss added to graphic panel

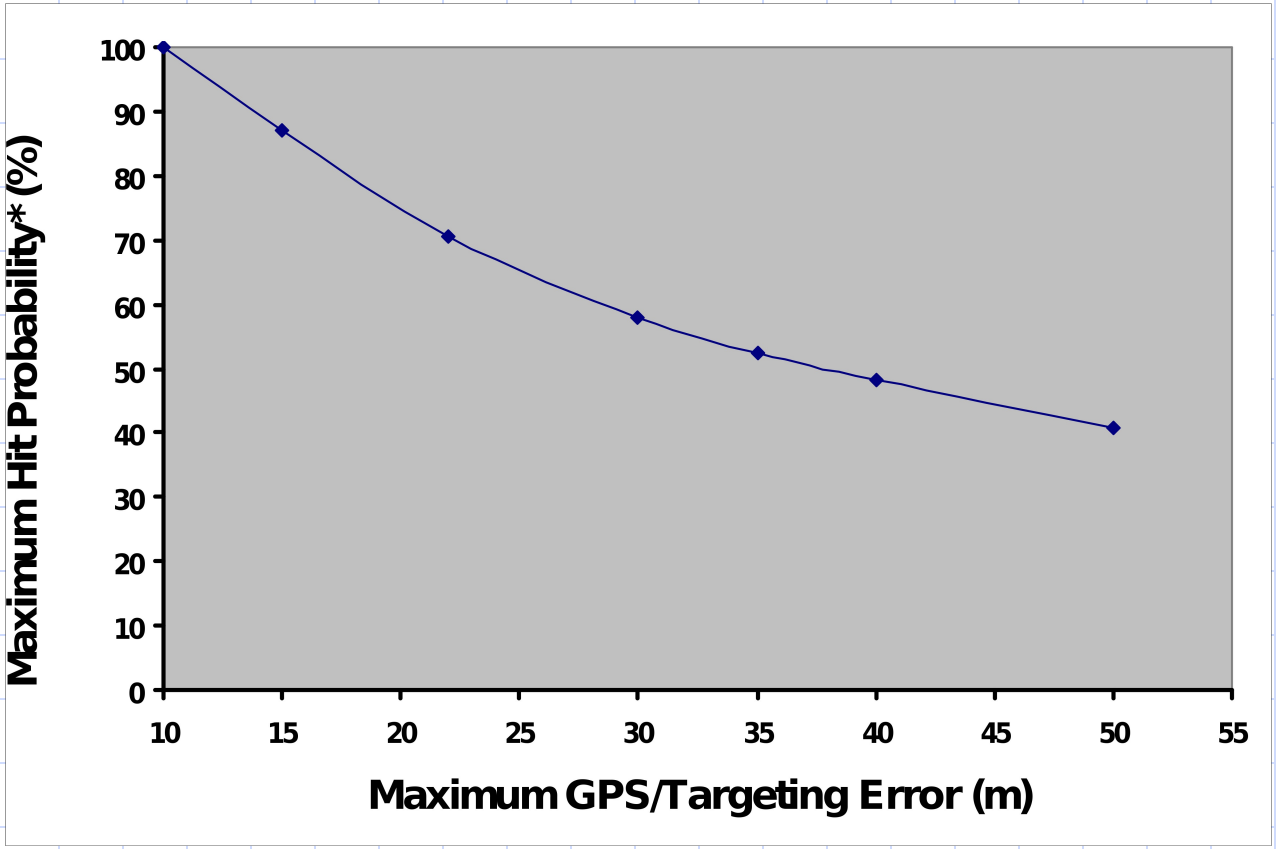

ShipTargeting
Missile
1
+getXPos() : double
+getYPos() : double
MovingTarget
1..*
+getXPos() : double
+getYPos() : double
+getHeading() : double
+getTurnRadius() : double
+calcNewPosition(in c : string, in t_str : string, in v_str : string, in radius_str : string) : void
+impactWithMissile(in msl : Missile) : bool
GraphicPanel
1..*
+addHit(in x : double, in y : double) : void
+addMiss(in x : double, in y : double) : void
+setShipPosition(in movTgt : MovingTarget) : void

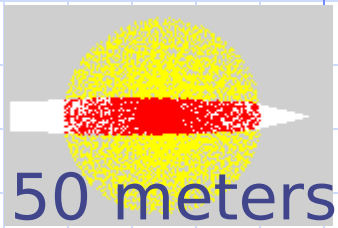
Sample Effectiveness Graph

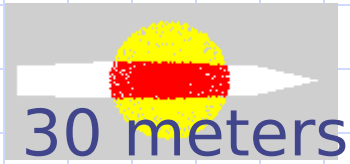


* 22 meter GPS/Targeting Accuracy used to obtain results

Targeting Accuracy Comparison







* Maximum Hit Probability occurs when targeted ship remains at constant speed and does not turn

Further Recommendations

- Simulation Program Improvements
  - Higher fidelity accuracy distribution
  - More realistic motion models for missile and target
- Future Studies
  - Determine the true targeting accuracy levels that can be reached
  - Verify that an acceptable communication rate to the missile can be achieved

Conclusions

- Calculations show that Tomahawk has a possibility of successful attack against slowly moving targets the size of modern warships
- Probability increases with low detection rates of the incoming missile by the intended target
- Off-board fire control solution can be used with no modifications to Baseline IV TWS
- Further study and research (with more detailed data) can determine the most appropriate operational employment constraints

Questions?

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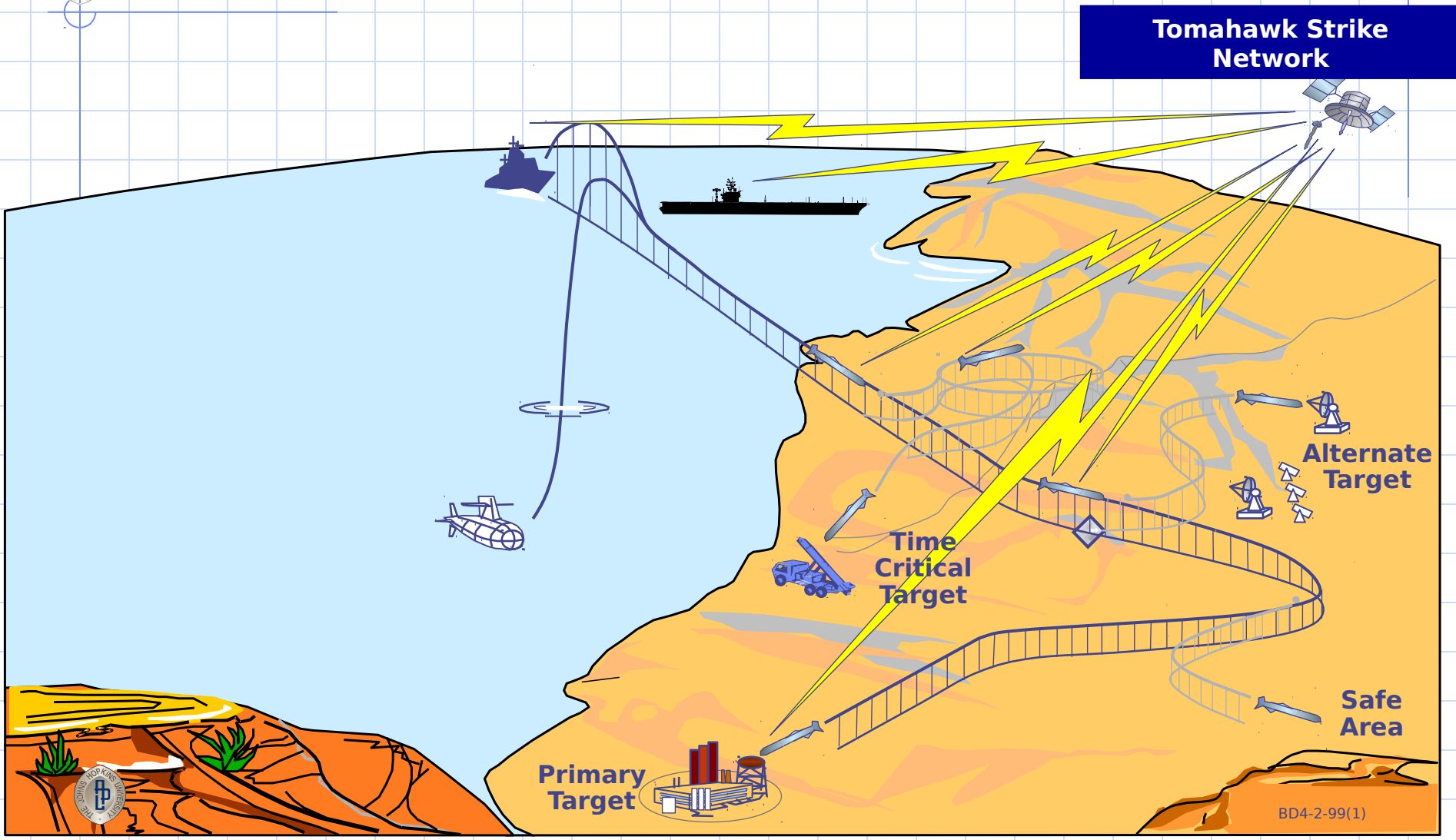
Block IV Tomahawk Overview



Tomahawk Strike Network